DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

INTEGRATED TERMINAL WEATHER SYSTEM (ITWS)

TEST AND EVALUATION MASTER PLAN (TEMP)

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1.0 INTRODUCTION.

1.1 BACKGROUND.

This Integrated Terminal Weather System (ITWS) Test and Evaluation Master Plan (TEMP) lays the foundation for the ITWS test strategy, resources, and implementation responsibilities. The test efforts governed by this TEMP will ensure the ITWS meets the system and subsystem requirements allocated to the project in the NAS-SS-1000, NAS-SR-1000, and FAA-E-XXXX (ITWS System Specification). This TEMP further describes the Test and Evaluation (T&E) components for meeting program objectives for each acquisition phase. The ITWS will follow the procedures for Operational Test and Evaluation (OT&E) stated in FAA Order 1810.4B. The TEMP format is in accordance with FAA-STD-024b.

The ITWS integrates weather data from terminal area sensors to provide value-added, real-time products that need no meteorological interpretation. ITWS products will be tailored for immediate use by terminal air traffic controllers, traffic managers, and automated traffic management systems. There are thirty-seven systems planned for deployment.

The ITWS procurement will meet Mission Need Statement (MNS) requirements by using Commercial-Off-The-Shelf (COTS) hardware and Government Furnished Equipment (GFE) algorithms for ITWS product generation. Additionally, the software used by the Massachusetts Institute of Technology Lincoln Laboratory (MIT/LL) to implement the algorithms will be supplied to the contractor as Government Furnished Information (GFI). The ITWS program has received KDP-3 approval, pending approval of this TEMP.

This TEMP addresses the testing requirements for the Initial Operational Capability (IOC) of the ITWS program. The IOC requirements are not finalized, and when discrepancies occur, the TEMP will identify these areas as To Be Determined (TBD). An updated TEMP will be developed with additional detail as the program progresses, through KDP-3 and KDP-4, to ensure compliance with program objectives. This TEMP and subsequent versions will be submitted for approval by the Test Policy Review Committee (TPRC). The results of both Development Test and Evaluation (DT&E) and OT&E testing will be utilized as input for a deployment recommendation decision.

Demonstration/Validation (DEMVAL) OT&E took place in Dallas/Fort Worth and Orlando in 1993 and in Memphis and Orlando in 1994. Additional testing in the operational environment is scheduled at the Dallas/Fort Worth (DFW) metroplex for the summer of 1995. These DEMVALs mitigated risk by allowing the user and test

community to evaluate ITWS product suitability, usefulness and meteorological validity in an operational environment and determined the feasibility to proceed to full scale development. The results of the demonstration phase OT&E verified that the weather products are acceptable to the user community.

Real-time source weather information, interfaces and test data sets generated by a contractor built Test Data Emulator, are planned to be used as input for weather scenarios at first article sites. OT&E testing is planned to begin in the 1998 time frame at the FAA Technical Center and at simple (e.g. single airport and single weather radar inputs) and complex (e.g. multiple airports and multiple radar inputs) airports. OT&E is planned to be completed during the 1st quarter 1999.

The ITWS project (CIP 63-21) is a Level I major system acquisition which will provide coverage for the 45 airports having Terminal Doppler Weather Radar (TDWR). Some of these airports are supported from one common Terminal Radar Approach Control (TRACON) facility or a Metroplex Control Facility (MCF); therefore, only 34 operational ITWS processing elements will be required. The ITWS program has been designated for oversight by the Office of Independent Operational Test & Evaluation (IOT&E) per FAA Order 1810.1F.

The National Airspace System Change Proposal (NCP) 17331 dated April 13, 1995 and the Operational Requirements Document (ORD), dated February 1995 were the primary source documents used for the development of this TEMP.

1.2 PURPOSE.

The purpose of this TEMP is to define the overall T&E strategy necessary to ensure the successful integration of the ITWS into the NAS and to assure the operational suitability and effectiveness of the ITWS. This TEMP describes the T&E processes that will be used to ensure the ITWS system is operationally ready and meets the project requirements.

The ITWS TEMP test strategy includes: (1) defining test methodology; (2) verifying requirements, Critical Operational Issues (COI), Critical Performance Parameters (CPP), and Minimum Acceptable Operational Performance Requirements (MAOPR) and (3) identifying organizational roles and responsibilities. ITWS COIs, CPPs, and MAOPRs are defined in the ITWS ORD. This TEMP is developed in accordance with FAA Order 1810.4B and FAA-STD-024b. A Verification Requirements Traceability Matrix (VRTM) containing high level functional and performance requirements to be tested during the ITWS T&E program is included.

1.3 SCOPE.

This ITWS TEMP specifically addresses the IOC ITWS which will be tested during the Development Phase and subsequent Production Phase. The FAA T&E overview begins with the MNS and continues through Production Acceptance Test and Evaluation (PAT&E). The testing that has taken place during the Demonstration Phase and the testing that will be performed during the Development Phase will ensure that the IOC ITWS satisfies KDP-3 exit criteria, NAS-SS-1000 Specifications, MAOPR, and CPP requirements.

There will be Four First Article Systems. Of these, OT&E integration will be conducted on three units, which include a unit at the FAA Technical Center for interface and integration testing, and an operational simple and complex test site (locations TBD). A simple site is defined as a single airport TRACON with single TDWR, Airport Surveillance Radar Model 9 (ASR-9), and Next Generation Weather Radar (NEXRAD) inputs. A complex site is defined as a multi-airport TRACON with multiple TDWR, ASR-9, and possibly, NEXRAD inputs. The fourth unit will be delivered to the Program Support Facility (PSF) in Oklahoma City, for maintenance procedural and shakedown test development.

The FAA Technical Center will be used for the initial phase of OT&E testing. The testing done on the system at the FAA Technical Center will assure NAS interfaces and operational functionality before the ITWS is placed in an operational field site.

OT&E operational and shakedown testing will be conducted at 2 operational field sites. The selected simple and complex site will offer a broad spectrum of convective activity including both air mass differentials and frontal systems. The simple site will assess the minimum interface functionality, while the complex site will assess the interfaces with multiple airports and radar systems within an operational environment. Both sites will assess the interface functionality, operational effectiveness and suitability within an air traffic environment.

The KDP-2 ITWS Acquisition Memoranda did not identify any technical capabilities that had to be met prior to entering KDP-3. In addition, since the operational capabilities demonstrated during Demonstration phase OT&E are not commercially available, there is no value to performing an Operational Capability Demonstration (OCD).

.2.0 REFERENCE DOCUMENTS.

The following specifications, standards, publications, orders and other miscellaneous documents were used in preparation of this document as well as subsequent lower level test documents and test reports.

FAA DOCUMENTS

FAA Specifications

NAS-SS-1000	NAS System Specification Volume I, Functional and Performance Requirements for the National Airspace System General.
NAS-SS-1000	NAS System Specification Volume II, Air Traffic Control Element Requirements for the National Airspace System.
NAS-SS-1000	NAS System Specification Volume III, Functional and Performance Requirements for the Ground-to-Air Element.
NAS-SS-1000	NAS System Specification Volume IV, Functional and Performance Requirements for the NAS Communications Element.
NAS-SS-1000	NAS System Specification Volume V, Functional and Performance Requirements for the National Airspace System Maintenance and Operations Support Elements.
NAS-SR-1000	NAS System Requirements Specification.
NAS-DD-1000	NAS Level I Design Document.
NCP 17331	NAS Change Proposal, April 13, 1995.
FAA-E-XXXX	Specification for the Integrated Terminal Weather System, March 1995.
FAA-G-2100F	Electronic Equipment, General Requirements, November 15, 1993.

FAA Standards

FAA-STD-018a	Computer Software Quality Program Requirements, September 30, 1987.

FAA-STD-013b	Quality Control Program Requirements, September 28, 1989.
FAA-STD-019a	Lightning Protection, Grounding, Bonding, and Shielding Requirements Facilities, September 1985.
FAA-STD-020a	Transient Protection, Grounding, Bonding, and Shielding Requirements Facilities, September 1985.
FAA-STD-024b	Preparation of Test and Evaluation Plans and Test Procedures, August 22, 1994.
FAA-STD-026	NAS Air Space Software Development, August 4, 1993.
FAA-STD-039	National Airspace System (NAS) Open System Architecture and Protocols, January 1992.

Other FAA Publications

NAS-MD-793A	Remote Maintenance Monitoring System Functional Requirements for the Remote Monitoring Subsystem (RMS).
FAA Order 1810.1F	FAA Acquisition Process, March 19, 1993.
FAA Order 1810.4B	FAA NAS Test and Evaluation Policy, October 22, 1992.
FAA Order 1810.6	Policy for Use of Non-developmental Items (NDI) in FAA Acquisitions, November 13, 1992.
FAA Order 1800.58	National Airspace Integrated Logistics Support Policy, July 1987.
FAA Order 6000.30B	Policy for Maintenance of the National Airspace System (NAS) Through the Year 2000, October 28, 1991.
NAS-MD-110	Test and Evaluation (T&E) Terms and Definitions For The National Air Space System, March 27, 1987.
ITWS Acquisition Plan	Integrated Terminal Weather System Acquisition Plan, October 1994.
ITWS ORD	Integrated Terminal Weather System Operational

Requirements Document (ORD), February, 1995.

ITWS PIP — Program Implementation Plan (PIP) for Integrated Terminal Weather System (ITWS), October 1994.

Risk Management — Integrated Terminal Weather System (ITWS) Risk Management Plan (Draft) September 1994.

ITWS MNS — Mission Need Statement Integrated Terminal Weather Systems (ITWS) February 1995.

Interface Documents

NAS-IR-25082514 — Interface Requirements Document, AWOS Data Acquisition System to the Integrated Terminal Weather System (ADAS/ITWS), July 31, 1994.

NAS-IR-25142513 — Interface Requirements Document, Integrated Terminal Weather System to the Data Link Processor (ITWS/DLP2A), July 31, 1994.

NAS-IR-31052514 — Interface Requirements Document, Integrated Terminal Weather System to Terminal Doppler Weather Radar (TDWR/ITWS), Part One, July 1, 1993.

NAS-IR-31052514 — Interface Requirements Document, Integrated Terminal Weather System Situation Display to Terminal Doppler Weather Radar (TDWR SD/ITWS), Part Two, July 1, 1993.

NAS-IC-31053102 — Interface Requirements Document,Terminal Doppler Weather Radar to Low Level Windshear Alert System (TDWR/LLWAS), May 1994.

NAS-IR-TBD — Interface Requirements Document, Airport Surveillance Radar - Model 9 (ASR-9) Weather Channel with the Integrated Terminal Weather System (ITWS) ASR-9 (Weather Channel)/ITWS, February 15, 1994.

NAS-IR-43020001c — National Airspace Data Interchange Network (NADIN)X.25 Packet Mode Users Interface Requirements Document, March 1992. (Appendix for Users, March 1995).

NAS-IR-43020001c — National Airspace Data Interchange Network

(NADIN)X.25 Packet Mode Users Interface Requirements Document, March 1992. (Appendix for ACF SD, March 1995).

NAS-IR-51035101 Interface Requirements Document, Remote Monitoring Subsystem/Maintenance Processor Subsystem (RMS/MPS), December 1994.

NAS-IR-43034001 Interface Requirements Document, National Weather System to NWSTG/NAS Users system, October 24, 1994.

Unisys 1208304I Interface Control Document, for the NEXRAD/RPG/non-associated PUP, June 1993.

OTHER STANDARDS

ANSI X3.66 American National Standard for Advanced Data Communications Control 1979 Procedures (ADCCP), January 1979.

EIA-232-D Interface between Data Terminal Equipment and Data Communications Equipment and Data Communications Equipment Employing Serial Binary Data Interchange, (See ref in text).

EIA-530 High Speed 25-Position Interface for Data Terminal Equipment and Data Circuit Terminating Equipment, March 1987.

CCITT X.25 Interface between Data Terminal Equipment (DTE) and Data Communications Equipment (DCE) for Terminals Operating in Packet Mode on Public Data Networks, 1984.

WMO No. 306 World Meteorological Organization Manuals on Codes.

ISO 7498 Information Processing Systems - Open Systems Interconnection - Reference Model

MILITARY STANDARDS

DOD-STD-2167A Defense System Software Development, February 29, 1988.

MIL-STD-470B Maintainability Program Requirements (for System and Equipments), May 30, 1989.

MIL-STD-785	Reliability Program for Systems and Equipment Development and Production, August 5, 1988.

MISCELLANEOUS REPORTS

ACW-200 Report	ITWS Demonstration/Validation Phase OT&E Final Report, (DRAFT), February 1995.
DOT/FAA/CT	Final Report for the Air Traffic Control (ATC)
TN95/1	Operational Evaluation of the Prototype Integrated Terminal Weather System (ITWS) at Dallas/Fort Worth (DFW) and Orlando International (MCO) Airports (May - September 1993).
Human Factors Plan	Integrated Terminal Weather System (ITWS) Human Factors Plan, March 1995.
Project Report	Integrated Terminal Weather System (ITWS) ATC-203 1992 Annual Report Lincoln Laboratory, Massachusetts Institute of Technology, September 7, 1993.
MIT/LL	ITWS Demonstration and Validation Operational Test and Evaluation, March 15, 1995, Draft, Report DOT/FAA/RD-95/7.

3.0 INTEGRATED TERMINAL WEATHER SYSTEM DESCRIPTION.

3.1 ITWS IMPLEMENTATION.

The ITWS hardware will consist of a COTS based computer system. The Meteorological Algorithm Specification developed by MIT/LL will be provided to the contractor as GFE. The software code that MIT/LL used to implement the algorithms during the DEMVAL will be provided to the contractor as GFI.

3.2 ITWS FUNCTIONAL DESCRIPTION.

The ITWS will collect, integrate, and process weather data from FAA and National Weather Service (NWS) sensors and from aircraft in the terminal area to provide value-added, real-time products that are usable without meteorological interpretation. These products include current terminal area weather and short term (0-30 minutes) predictions of significant weather phenomena. ITWS

products will be generated for immediate use and are available to air traffic control personnel, traffic managers, supervisors, automated traffic management systems, and pilots via data link. ITWS products will also be provided to other users with defined requirements.

Figure 3.2-1 is a high level presentation of the ITWS information flow. Table 3.2-1 presents the information in greater detail for each of the ITWS products and their associated capabilities.

Figure 3.2-1 ITWS Information Flow Diagram

Table 3.2-1 ITWS IOC products

	ITWS PRODUCTS	CAPABILITY
a.	Windshear: 1) Microburst detection/prediction 2) Gust front detection and forecast 3) Ribbon display alerts 4) Microburst alert Automated Terminal Information System (ATIS) timer 5) Wind shear alert ATIS timer 6) Gust front impact timer	Accurate detection/prediction and alerting of microbursts including location, runway impact and intensity; Improved gust front detection and forecasts; Timers (ATIS/700 and Gust front impact);
b.	Gust front wind shift estimate	Estimate of wind speed and direction 10 minutes behind the gust front;
c.	Precipitation: 1) 5 nautical mile range 2) TRACON range 3) 100 nautical mile range 4) 200 nautical mile range	Precipitation intensity, location and extent in 4 ranges; TRACON precipitation with ASR-9 AP removed;
d.	Storm motion and extrapolated position: 1) 5 nautical mile range 2) TRACON range 3) 100 nautical mile range 4) 200 nautical mile range	Indication of storm speed and direction; Near-term projected storm location, and extent depicted in 4 ranges;
e.	Storm cell information: 1) 5 nautical mile range 2) TRACON range 3) 100 nautical mile range 4) 200 nautical mile range	Detailed data, on request, indicating storm features including: hail, lightning, mesocyclone and echo tops in 4 ranges;
f.	ASR-9 AP: 1) Precipitation with AP flagged 2) AP alert	Indication of location and extent of AP in the ASR-9 reflectivity; Alerting to the presence and location of ASR-9 AP;
g.	Tornado: 1) Detection 2) Alert	Indicate locations on SD in 4 ranges; Alert to the presence of tornadoes within designated distances of each ITWS airport;
h.	Airport lightning warning	Indication of lightning within designated distances

	ITWS PRODUCTS	CAPABILITY
		of each ITWS airport;
i.	LLWAS winds	Centerfield and runway-specific winds as designated to cover each ITWS airport;
j.	Terminal winds: 1) Gridded wind field 2) Wind profile	Profiles of winds for each ITWS airport for designated reference points and altitudes for display;
k.	Runway configuration	Airport configuration (runway configuration);
l.	Terminal weather text message	Provides a textual weather message for terminal area defining pressure, weather, visibility, ceiling, winds and remarks.

The ITWS will receive TDWR, ASR-9, and NEXRAD radar data. The ITWS will integrate this data with gridded data and Meteorological Data Collection and Reporting System (MDCRS) data received via the National Weather System Telecommunication Gateway (NWSTG), FAA Telecommunications Gateway (FAATG). Automated Weather Observing System (AWOS), Automated Surface Observing System (ASOS), Automated Lightning Detection and Reporting System (ALDARS) are received from the ASOS/AWOS Data Acquisition (ADAS). Data input, assimilation, and processing for product generation will occur in the ITWS product generator located at the TRACON building. The ITWS graphics and text products will be presented to supervisors and traffic managers on the Situation Display (SD). ITWS text products will be presented to Air Traffic Controllers (ATC) on the Ribbon Display Terminal (RBDT). The ITWS is required to:

1. Process data (real-time weather observation data), Aviation Impact Variables (AIV), and State of Atmosphere Variables (SAV). This processing could include performing data assimilation, interpolation, and running extraction and tracking algorithms.

2. Extract information from existing Aviation Weather Products (AWP) as input for generating new AWPs.

3. Provide direct or pass-through sensor data. This data can be used as received or as base data for a value added product.

3.2.1 ITWS Unique Operational and Performance Characteristics.

ITWS products are generated from data received from various input sensors and integrated into a single display and presented to end users in a form that does not require further meteorological interpretation. The ITWS will archive generated products, system status messages, and user inputs for a fifteen day cycle. Additionally, the ITWS will archive acquired data used for ITWS product generation for a 6 hour period.

3.3 INTERFACES.

The ITWS will interface with various FAA and NWS weather systems to fulfill its mission requirements. ITWS interfaces are divided into two categories, input interfaces and output interfaces (users) as shown in Figure 3.3-1. The following subsections describe each interface.

Each interface will achieve interoperability and compatibility using the International Standards Organization (ISO) Open System Interconnection (OSI) reference model, in accordance with ISO 7498 and FAA-STD-039. Messages and related format requirements are presented in each Interface Requirements Documents (IRD) and Interface Control Documents (ICD).

3.3.1 External Input Interfaces.

a. TDWR/ITWS

b. LLWAS/ITWS

c. ASR-9/ITWS

d. NEXRAD/ITWS

e. FAATG/ITWS

f. ADAS/ITWS

3.3.1.1 TDWR/ITWS.

This is a two part interface. For Part I, the TDWR will provide the ITWS product generator with data formatted and transmitted in accordance with NAS-IR-31052514 Part I. The data provided will include TDWR base data and Low Level Windshear Alert System (LLWAS) products.

For Part II, the TDWR will provide a direct interface to each ITWS SD in the TRACONs and Air Traffic Control Towers (ATCT).

This will provide a backup to be used by the SD and accompanying RBDTs in case of failure to receive data from the ITWS product generator. Data and protocols will be in accordance with NAS-IC-31052514 Part II.

Figure 3.3-1 System Architecture

3.3.1.2 LLWAS/ITWS.

The ITWS will interface to either LLWAS II or LLWAS III at each ITWS airport SD. The LLWAS II will provide threshold and center field wind data exclusively. The LLWAS III will supply runway oriented winds and windshear products. LLWAS data will be provided to the TDWR Radar Product Generator (RPG) for distribution to the ITWS product generator and for integration and distribution to the ITWS SD. LLWAS II/III also provides data directly to the SD as a backup to a TDWR and/or communications failure.

3.3.1.3 ASR-9/ITWS.

ASR-9 will provide digitized 6-level weather reflectivity data in accordance with the ASR-9/ITWS IRD. This document is currently being updated. This IRD defines the weather to be provided by the ASR-9. The ITWS will merge all ASR-9 inputs covering the TRACON area.

3.3.1.4 NEXRAD/ITWS.

NEXRAD will provide products in accordance with the RPG/associated Principle User Processor (PUP) ICD (Unisys 1208304I). The products will include the following data: storm structure, storm tracking, echo tops, hail index, mesocyclone, tornado vortex signature, mean radial velocity, and layered composite reflectivity. The data format and the communication protocol is defined in the NEXRAD/ITWS ICD.

3.3.1.5 FAATG/ITWS.

The NWS will provide gridded data and MDCRS-processed airborne observations to the ITWS. The information will be broadcast via high speed communications links. The communication protocols and subnetwork communications are defined in accordance with the NWSTG/NAS User IRD (NAS-IR-43034001).

3.3.1.6 ADAS/ITWS.

ADAS will provide the ITWS with automated surface observations and lightning network information via the NADIN Packet Switching Network (PSN). The provided ADAS information will be in accordance with the NAS-IR-25082514. ADAS will provide that portion of the raw lightning information which falls within the geographical area of the Area Control Facility (ACF). All data exchange at the application layer is in the World Meteorological Organization (WMO) format.

3.3.2 External Output Interfaces.

The set of products disseminated from ITWS to output systems will be tailored to meet the requirements of each interface/user.

a. ITWS/External Users,
b. ITWS/Data Link Processor (DLP),
c. ITWS RMS/Maintenance Processor Subsystem (MPS),
d. ITWS/National Airspace Data Interchange Network (NADIN).

3.3.2.1 ITWS/External Users.

Output ports will be provided to transmit terminal weather products for access by external users such as airlines and the NWS. The format of messages provided over these ports will be consistent with those defined in the ITWS product generator to ITWS SD interface ICD.

3.3.2.2 ITWS/DLP2A.

ITWS products will be provided to the Data Link Processor (DLP) for dissemination to pilots in accordance with NAS-IR-25142513. This interface is between the ITWS and the DLP located in each ACF. The application processes shall provide only those services required for the transfer of ITWS products to the DLP (one way operation). Interface Functional requirements shall be in accordance with ISO 7498.

3.3.2.3 ITWS Remote Monitoring System (RMS)/ Maintenance Processor Subsystem (MPS).

Each ITWS will incorporate a RMS, which will supply system status to the MPS. The interface will be in accordance with NAS-IR-51035101. The NAS-MD-793a provides the RMS design implementation requirements and will be used in conjunction with this IRD. The MPS and RMS application processes shall exchange messages that the RMS is required to provide to the MPS.

3.3.2.4 ITWS/National Airspace Data Interface Network II (NADIN II) Packet Switching Network (PSN) User.

NADIN will be used as the communications medium between ITWS and the external systems to provide the data for the exchange of messages. The requirements for the connectivity are defined in NAS-IR-43020001c.

3.4 CRITICAL PERFORMANCE PARAMETERS (CPP).

The ITWS CPPs are presented in Table 3.4-1. The objectives and

thresholds are extracted from the ITWS ORD. The thresholds are baselined in NAS-SS-1000 as required NAS parameters. A performance parameter's threshold is the minimum value necessary to provide an operational capability that will satisfy the mission need. Performance objectives are defined as values beyond the threshold that should reflect an operationally meaningful, measurable and affordable improvement on operations or support beyond that provided by the threshold value.

Table 3.4-1 ITWS Critical Performance Parameters

CRITICAL PARAMETER	THRESHOLD	OBJECTIVE
A) General Performance		
1) End-to-end availability	Essential Service for wind shear (MB, WS, & GF) requirements (end-to-end availability >/=.999)	Objective = Threshold
2) ITWS allocated availability	>/=.99981	Objective = Threshold
3) ITWS reliability	>/=2704 hours mean time between failure (MTBF)	Objective = Threshold
4) Coverage area	Surface-23,000 feet above ground level (AGL) out to 30 nm beyond the TRACON boundary, product dependent	Objective = Threshold
5) Data Retention	6 hours of input data	Objective = Threshold
6) Product archiving	15 days of ITWS products directly supporting display or user output	Objective = Threshold
7) Automatic recovery on ITWS generation failure	Switch to TDWR display within 30 seconds of ITWS wind shear product outage	Objective = Threshold
8) Timeliness of reporting weather phenomenon (tornado, hail, mesocyclone)	</=1 minute of receipt of applicable data	Objective = Threshold
B) Wind shear and storm products generation performance		
1) Microburst Prediction		
a) Probability of false microburst alert	</=0.1	</=0.05
b) Prediction lead time	</=2 minutes, prior to onset of microburst for *60%* of predicted valid wet microbursts	</=2 minutes, prior to onset of divergent wind shear for *90%* of wet predicted events
2) Gust Front Forecast		
a) Predicted position time	Position predicted 10 minutes and 20 minutes in advance	Objective = Threshold
b) Predicted position accuracy	Predict *70%* of gust fronts impacting airport with wind	Predict *90%* of gust fronts impacting airport with wind change

CRITICAL PARAMETER	THRESHOLD	OBJECTIVE
	change >/=15 knots 10 minutes in advance	>/=15 knots 10 minutes in advance
c) Probability of false prediction	Probability of false 10 minute prediction </= *0.10* for gust fronts with wind change>/=15 kts	Probability of false 10 minute prediction </= *0.10* for gust fronts with wind change >/=15 knots
3) Storm motion		
a) Storm speed accuracy	±5 knots for 90% of storm events moving at >/= *10* knots	±5 knots for 90% of storm events moving at >/= *5* knots
b) Storm direction	±20 degrees for *90%* of storms moving at >/= *10* knots	±20 degrees knots for 90% of storms moving at >/=*5* knots and ±*10* degrees for *50%* of storms moving at >/= *5* knots
4) Storm extrapolated position		
a) Extrapolated position times	Position projected 10 minutes and 20 minutes in advance	Objective = Threshold
b) Extrapolated position accuracy	*10*-minute extrapolation within 2 nm for *80%* of storms moving at speeds > 10 knots, excluding storms with growth, decay >/= 2 levels (TRACON product)	*20*-minute extrapolation within 2 nm for *70%* of storms moving at speeds > 10 knots (TRACON product)
5) Storm cell information		
a) Storm cell association	>/= *90%* of features associated to correct cell	>/= 95% of features associated to correct cell
b) Storm cell information	Threshold = Objective	Identify 80% of cells which will grow or decay by over 20% in area in next 20 minutes
6) ASR-9 AP edit		
a) Inadvertent edit	</= a maximum of $10km^2$ or 10% of contiguous area with weather reflectivity >/= level *3*	</= a maximum of $10km^2$ or 10% of contiguous area with weather reflectivity >/= level *2*
b) Latency	</=30 seconds of ASR-9 update	Objective = Threshold
c) Edit performance	Edit *70%* of AP when ASR-9 level is >/=level 3 and >/=2 levels over actual reflectivity level, & AP >/= $25km^2$	Edit 85% of AP when ASR-9 level is >/=level 3 and >/=2 levels over actual reflectivity level, & AP >/= $25km^2$

CRITICAL PARAMETER	THRESHOLD	OBJECTIVE
C) Winds Products generation performance		
1) Terminal winds		
a) Horizontal resolution	± *5* nm out to 30 nm beyond TRACON </= 23000 feet	± *1* nm within TRACON boundaries </= 18000 feet; 5 nm elsewhere
b) Vertical resolution (between levels)	50 millibars	25 millibars < 5000 feet AGL and </= 15 nm of the TDWR radar; 50 mb elsewhere
c) Accuracy	+10 knots 80% of time in regions and at times when both TDWR and NEXRAD have valid velocity data	+5 knots 90% of time in regions and at times when both TDWR and NEXRAD have valid velocity data

3.4.1 Exit Criteria.

Products presented in Table 3.2-1 must meet the technical/operational requirements as determined by the Associate Program Manager for Test (APMT)/Integrated Product Team (IPT) reflected in the CPP list presented in Table 3.4-1. The ITWS program has identified the following exit criteria for the DT&E and OT&E phases:

DT&E

- ITWS must successfully pass system specification requirements;
- ITWS must successfully pass NAS-IR requirements of available interfaces;
- ITWS must successfully demonstrate performance of the contractor developed software on data sets containing various meteorological phenomena;
- ITWS must meet technical parameters identified in the FAA-E-XXXX;
- OT&E test personnel training must be conducted;
- Pass/Fail criteria for DT&E requirements within the VRTM.

OT&E

- ITWS documentation must be updated prior to KDP-4;
- First article units must be delivered to 4 sites;
- Physical Configuration Audit (PCA)/Functional Configuration Audit (FCA) must be conducted;
- Maintenance must be established for first articles;
- Airway Facility (AF) and Air Traffic (AT) training must be conducted;
- Successful completion of OT&E;
- Site adaptability;
- Back-up modes TDWR/LLWAS;

- Pass/Fail criteria for OT&E requirements within the VRTM.

3.5 CRITICAL OPERATIONAL ISSUES (COI).

COIs address uncertainty or risk associated with an operational system. They can be categorized into two areas, operational effectiveness issues, reflecting requirements of the FAA operational user, and operational suitability issues, reflecting support and maintenance requirements. The ITWS program has developed a structured approach to identify, manage, and resolve issues associated with each COI.

The mitigation of COIs is a continuing process from prototype operations (DEMVALs) throughout the procurement lifecycle. The COIs listed below include those from the ORD and the 1994 DEMVAL. Section 5.2 represents a subset of these COIs specifically related to the 1994 DEMVAL.

a. Will input sensor quality be adequate?

Resolution of this COI began with the 1994 DEMVAL in Memphis and Orlando and will continue by demonstrating the availability and performance of the initial ITWS functions at representative sites. Additionally, analyses using measured statistics for input availability will also be utilized. Functional prototypes at Memphis (MEM), Orlando (MCO), and Dallas/Ft. Worth (DFW) will continue to validate the capability of the key sensors prior to delivery of the first article ITWS. Testing on the first article systems will further validate the availability, performance and service volume of the initial ITWS functions using the operational data interfaces.

Commissioned input sensors will be utilized, therefore the data quality, in general, should not be an issue. However, input data quality will be monitored to ensure data integrity. Inherent limitations of input sensor data (Anomalous Propagation [AP], cone of silence, etc.) will be compensated for by utilizing available sensors which provide the most accurate data for a given condition. For example, TDWR reflectivity will be used for the five mile range (where ASR-9 tends to be less sensitive) and NEXRAD will be used to edit ASR-9 AP.

Utilizing this approach mitigates the sensor quality issue. The inherent limitations will be tested both in the DT&E and OT&E phases. Test scenarios will be developed to examine both raw base data for a given sensor (e.g., raw ASR-9 data) and the compensated data to verify the improved quality. Also AT personnel will provide a qualitative evaluation for this COI.

b. Will the algorithms and hardware function properly in a large TRACON environment, with multiple TDWRs, ASR-9s and NEXRADs?

Resolution of this COI will be achieved through evaluating the ITWS at complex sites utilizing multiple sensor inputs. The proposed test strategy defined throughout section 5.0 of this document will ensure that this COI is addressed and resolved.

The functional prototype at DFW in 1995 will provide background to evaluate this COI. Multiple ASR-9 data archived/recorded in 1993, by MIT/LL (for DFW) will also be analyzed. The functionality of the hardware and algorithms will then be tested by the contractor during DT&E, using the GFE algorithm and the contractors implementation of the software. The phased approach of OT&E specifically tests the multi sensor environment using a combination of sensors and test drivers first at the FAA Technical Center and subsequently at the designated MCF. This testing should resolve this COI.

c. Can the effectiveness demonstrated at the DEMVAL locations be achieved at other ITWS airports given regional climatic differences, diverse airport equipage and availability of inputs?

The resolution of this COI will begin by continuing to collect data on the accuracy and operational effectiveness at the ITWS test sites. Additionally, data obtained at DFW during the summer of 1995 will be analyzed to determine the effectiveness of the ITWS. This data set will be an additional point to evaluate the robustness of the ITWS algorithms and their effectiveness in different regional climates.

Thereafter, data sets from other representative climate areas and diversely equipped airports will be collected and run through the ITWS algorithms. Data will be recorded at major TDWR equipped airports in the northeast and upper midwest during convective seasons to complement the Florida, mid-south and southwest climatic data from the functional prototype sites.

During the contractor conducted DT&E, data sets representing the diverse climates and equipment will be tested on the contractor implemented software. Additionally, the validity of the algorithms will be verified.

At the FAA Technical Center, live interfaces will be introduced to further test the effectiveness of the algorithm, which will be followed by simple and complex site as part of operational and shakedown testing. OT&E using initial ITWS articles will be carried out at two sites which are different from those selected

for functional prototype testing and recorded data evaluations.

d. Can the ITWS aid in maintaining effective airport capacity during adverse weather conditions?

This COI will be verified by demonstrating the improved effective capacity (and reduced delays) provided by the initial ITWS functions at operational airports. Demonstration OT&E testing using functional prototypes at Memphis and Orlando demonstrated that operational procedures to utilize the ITWS products improved effective capacity. Additional testing using functional prototypes at Memphis, Orlando and Dallas/Ft. Worth will further validate the effective capacity provided by the initial ITWS prior to delivery of the first article.

ACT-320 will perform analysis on data provided by MIT/LL and Air Traffic on airport capacity prior to ITWS installation at the OT&E airports and post ITWS installation. OT&E will also use some qualitative analyses techniques (i.e. questionnaires) to augment the quantitative data analyses.

e. Are the ITWS products usable without the need for meteorological interpretation?

The status of this COI was stated as resolved in the Draft 1994 DEMVAL report. This was based on the Demonstration OT&E testing using functional prototypes in Memphis and Orlando. Evaluations of ITWS prototype operations in MCO, MEM and DFW will assure the continued resolution of this COI. Additionally, the following testing and oversight will occur to certify the implementation of the contractor developed software algorithms:

The Science Panel will be reconvened to assure the science behind the ITWS Algorithms remains valid;

An independent group will oversee the meteorological verification of the ITWS algorithms using various product sets and assess the process throughout the Development Test phase, and;

The Specification will require discrete points in the software that will allow the contractor and the government to inject data to prove the contractors GFE algorithms and the contractors GFI software give the required results.

AF personnel will also be involved during the DT&E and OT&E testing to assure this COI continues to be resolved. In addition, the ITWS products have been developed and approved in conjunction with the ITWS User Group. The above efforts

should continue to assure this COI remains resolved.

f. Is the ITWS resilient under loss of input from interfaced systems/sensors e.g. TDWR, ASR-9, Remote Maintenance Monitoring System (RMMS), and NEXRAD?

Demonstration Phase OT&E testing using functional prototypes in Memphis and Orlando have shown that the ITWS will produce useful products under the loss of sensor or interface inputs. This will be further verified during future functional prototype operations in Memphis, Orlando, Dallas/Ft. Worth and OT&E.

As with other COIs the DT&E testing using data sets and specification requirements will further mitigate the risk posed by this COI. Specific OT&E testing will be conducted at the FAA Technical Center and at the operational sites to further resolve this COI; inputs from interfaced systems/sensors will be faulted during OT&E to verify that the ITWS responds as specified when various inputs are lost and that the system recovers properly when the inputs are restored. Table 3.2-1 in the ITWS ORD addresses the impact on specific ITWS products upon input sensor failure.

Airway Facilities personnel will conduct testing on Reliability, Maintainability and Availability of supporting sensors during shakedown testing. The above efforts should continue to assure this COI remains resolved.

g. Are the ITWS products suitable for air traffic use?

An assessment of the ITWS products using contractor implemented software will be performed. This testing will be qualitative in nature using AT personnel both at DT&E and the phased OT&E to continue to assure resolution of this COI. Previous Demonstration Phase OT&E testing of functional prototypes in Memphis and Orlando, indicated that the ITWS products are suitable for air traffic use. Additionally, the ITWS products developed in conjunction with the ITWS User Group will continue to be evaluated to ensure the resolution of this COI.

h. Does the ITWS meet the critical performance threshold requirements of the ORD?

The status of this COI from the 1994 DEMVAL report is partially resolved. The prototype will continue to be monitored during the 1995 DEMVAL at DFW, MEM and MCO with additional analyses performed. The Lincoln Laboratory "Integrated Terminal Weather System (ITWS) Demonstration and Validation Operational Test and Evaluation" report statistics will also be examined, and DT&E

data sets will further validate the threshold requirements. During OT&E using meteorological and statistical analysis output data will be compared with raw sensor data to verify product accuracy.

The scientific community accepts this method as a valid process to assess truth. The meteorological validation team will provide further independent assessment to assure resolution to this COI.

i. Do the ITWS products enhance the effectiveness of traffic planning/management (delays, airport acceptance rate, traffic flow, etc.) during adverse conditions in the terminal area? Are terminal airspace and runways used more effectively?

This COI was resolved during the 1994 DEMVAL at Memphis and Orlando where OT&E testing using functional prototypes demonstrated that operational procedures to utilize the ITWS products improved effective capacity. Additional testing using functional prototypes at Memphis, Orlando and Dallas/Ft. Worth will further validate the resolution by examining the effective capacity provided by the initial ITWS prior to delivery of the first article. Resolution will be obtained from pre-ITWS air traffic measures and questionnaire evaluations.

j. Is the ITWS display visible under anticipated lighting conditions?

This COI will be resolved by means of specification requirements and system use within the operational environment.

k. Does the ITWS reduce (perceived) controller workload during adverse weather conditions in the terminal area?

The results of the workload scale administered to air traffic personnel in conjunction with previous Demonstration Phase OT&E testing in Memphis and Orlando, clearly indicated that perceived workload is reduced during adverse weather conditions. The results of the workload scale are contained in the "ACT-320 ITWS DEMVAL Phase OT&E Final Report".

Additional workload data will be collected in conjunction with the prototype OT&E at Dallas/Fort Worth in 1995, to further verify results obtained in 1994. A workload scale will be administered at the OT&E Integration and Operational Testing at the simple and complex sites.

3.6 MINIMUM ACCEPTABLE OPERATIONAL PERFORMANCE REQUIREMENTS (MAOPR).

Air Traffic Plans and Requirements Service (ATR)-330 has identified the ITWS MAOPRs requirements; they correspond to the threshold values of the CPPs in Table 3.4-1.

4.0 TEST & EVALUATION (T&E) PROGRAM MANAGEMENT.

4.1 MANAGEMENT.

The following subsections identify the roles and responsibilities for the organizations involved in the ITWS T&E process.

4.1.1 NAS Configuration Control Board (CCB).

1. Approves DT&E and PAT&E requirements contained in the project specification (e.g., project specification VRTM).
2. Approves test standards and definitions.
3. Approves NAS-SS-1000 NCPs and IRDs that affect system requirements.

4.1.2 Test Policy Review Committee (TPRC).

1. Supports T&E policy, test standards, and definitions.
2. Approves TPRC operating procedures.
3. Approves FAA TEMP and revisions.
4. Approves test policy waivers.
5. Resolves disagreements on T&E issues when agreements cannot be reached at lower levels of FAA management.

4.1.3 Aviation Weather Development Program, AND-460, ITWS Program Manager (PM).

1. Responsible for overall program management.
2. Presents T&E deployment issues to the Deployment Readiness Review (DRR).
3. Arranges with Alternate Program Manager for Test (APMT) for T&E support, coordination and monitoring through an annual Program Directive (PD).
4. Approves PD.
5. Tasks APMT to prepare PDs between the program office and other FAA organizations.
6. Requests funding for project T&E which is included in the overall program funding.
7. Responsible for receiving TPRC approval for the FAA TEMP.
8. Prepares test policy waiver requests, and submits them to the TPRC Secretariat.
9. Coordinates T&E requirements for Department of Defense (DOD), or other government agencies, on joint

procurement, as the project requires.

10. Develops, or has the APMT develop, the project specification VRTM, and incorporates these requirements into the project.
11. With APMT support, brings unresolved T&E issues before the TPRC via the TPRC Secretariat.
12. Approves DT&E test plans, procedures, and reports.
13. Reviews DT&E test plans, procedures, and reports.
14. Recommends to the contract officer (CO) approval of DT&E test plans, procedures, and reports.
15. Monitors DT&E contractor conducted testing.
16. Reviews OT&E Integration and OT&E Operational test requirements, plans, procedures, and reports.
17. Approves OT&E Integration and OT&E Operational test requirements, plan, procedures, and reports.
18. Monitors OT&E Integration and OT&E Operational tests.
19. Monitors OT&E Shakedown.
20. Reviews Field Shakedown requirements with the Airway Facilities Division organization.
21. Reviews Site Acceptance Test (SAT) test plans, procedures and reports.
22. Monitors Field Shakedown.
23. Oversees distribution for DT&E/SAT test plans, procedures, and reports.
24. Responsible for FAA TEMP distribution.
25. Responsible for identifying and prescribing appropriate distribution and accountability controls for program technology that is critical.
26. Prepares NCPs for designated test locations.

4.1.4 NAS Development Special Assistant (AND-3).

1. Member of TPRC.
2. Reviews FAA TEMP.
3. Supports development of revisions to test policy, test standards and definitions.

4.1.5 NAS Transition and Implementation Service (ANS).

1. Member of TPRC.
2. Provides supportable requirements to the APMT for inclusion in the FAA TEMP, which serves as guidance to AOS for the OT&E plans.
3. Reviews FAA TEMP's.
4. Reviews requirements, plans, and procedures for OT&E plans.
5. Provides personnel for conducting and/or monitoring the conduct of OT&E Shakedown.
6. Reviews OT&E Shakedown reports.
7. Reviews PDs.
8. Approves PDs.

4.1.6 Communication, Navigation and Surveillance Engineering and Test Division (ACT-300).

1. Member of the TPRC.
2. Provides APMT.
3. Prepares Project TEMP.
4. Reviews test plans.
5. Reviews DT&E, OT&E Integration and OT&E Operational test requirements.
6. Provides concurrence on OT&E Integration and OT&E Operational test plans and reports prior to review.
7. Presents unresolved T&E issues, significant T&E test result problems, or violations of T&E policy to the TPRC.
8. Provides T&E assessments to the DRR.
9. Provides for FAA Technical Center facility readiness.

4.1.7 Associate Program Manager for Test (ACT-320).

1. Supports development of test policy and test standards.
2. Acts as the agent of the PM to manage the T&E program; including establishing overall test schedules, coordinating tests, ensuring that all test requirements are satisfied, and that tests are performed in accordance with approved procedures.
3. Prepares, coordinates, and approves, with the PM, an annual PD which addresses all T&E task support activities and resources required for the project.
4. Prepares appropriate T&E inputs to project documentation, (e.g., project procurement package) as specifically tasked in the PD.
5. Prepares PD's between the project office and other FAA or DOD organizations to fund and/or arrange for the organizations' participation in T&E activities.
6. Jointly prepares and updates the FAA TEMP with the PM.
7. Provides updates of available test results during DRR
8. Reviews DT&E test requirements, plans, procedures, and reports.
9. Arranges DT&E and PAT&E test support.
10. Reviews DT&E and PAT&E test requirements.
11. Coordinates with performing organizations, and monitors DT&E, OT&E and PAT&E activities.
12. Reviews contractor-prepared DT&E and PAT&E plans, procedures, and reports.
13. Prepares DT&E and PAT&E test plans, procedures, and reports when tasked by the PM to develop hardware or software, instead of a contractor.

14. Directs and conducts DT&E testing if tasked by the PM/Associate Program Manager for Engineering (APME) and monitors DT&E testing performed by a contractor.
15. Reviews DT&E and PAT&E requirements for inclusion in the FAA TEMP.
16. Prepares OT&E Integration and OT&E Operational test requirements for inclusion in the FAA TEMP.
17. Prepares OT&E Integration and OT&E Operational test plans, procedures, and reports.
18. Reviews OT&E Shakedown requirements, plans, and procedures.
19. Directs and conducts OT&E Integration and OT&E Operational tests. AOS-250 may optionally participate in test conduct.
20. Reviews all OT&E Shakedown reports (information only).
21. Reviews Field Shakedown requirements, plans, procedures, and reports.
22. Monitors OT&E Shakedown.
23. Monitors Field Shakedown.

4.1.8 Air Traffic Plans and Requirements (ATR).

1. Member of TPRC.
2. Provides requirements for and reviews the FAA TEMP.
3. Provides operational expertise and planning for conducting and analyzing tests.
4. Reviews DT&E, OT&E and PAT&E requirements.
5. Provides personnel to support monitoring and conduct of DT&E.
6. Reviews program PDs.
7. Provides test requirements via the FAA TEMP, supports test plan development, and reviews test plans and procedures for OT&E Integration and OT&E Operational tests.
8. Provides and approves additional test requirements (that do not exceed OT&E Shakedown durations or costs as baselined in the FAA TEMP) not identified in the TPRC-baselined FAA TEMP for OT&E Integration and OT&E Operational tests. When change or additions are required which exceed cost or schedule allotments previously planned, the normal process for adjusting the planned testing and resolving disagreements applies.
9. Determines the operational acceptability of new ATC operational computer programs or systems prior to their delivery for operational testing and use in field facilities.
10. Provides personnel for conducting and/or monitoring the

conduct of OT&E Integration and OT&E Operational tests.
11. Reviews OT&E Integration and OT&E Operational test reports.
12. Provides and coordinates test requirements, supports test plan development, and reviews test plans and procedures for OT&E Shakedown.
13. Provides personnel for conducting and/or monitoring the conduct of OT&E Shakedown.
14. Reviews OT&E Shakedown reports.
15. Provides and reviews requirements, plans, and procedures for Field Shakedown.
16. Monitors the conduct of Field Shakedown.
17. Reviews Field Shakedown reports.
18. Provides a deployment recommendation based on OT&E Shakedown results, in support of the DRR.
19. Develops the ORD.

4.1.9 Operational Support Service (AOS).

1. Member of TPRC.
2. Identifies and develops with the PM and APMT, OT&E Shakedown requirements for inclusion in the FAA TEMP.
3. Optionally supplies draft PD, reviews and approves final PD.
4. Reviews FAA TEMP.
5. Reviews OT&E Integration and OT&E Operational test requirements, plans, and reports.
6. Monitors DT&E tests.
7. Monitors OT&E Integration and OT&E Operational tests, and optionally participates in OT&E Integration and OT&E Operational test conduct.
8. Prepares OT&E Shakedown requirements, plans, procedures, and reports in coordination with ATR.
9. Approves, in coordination with ATR, additional OT&E Shakedown requirements that do not exceed OT&E Shakedown durations or costs as baselined in the TEMP.
10. Approves OT&E Shakedown plans, procedures, and reports.
11. Directs and conducts OT&E Shakedown as applicable to OT&E requirements. ATR will support and participate in those tests that are applicable to ATR OT&E Shakedown requirements.
12. Provides personnel for performing and/or monitoring the conduct of OT&E Shakedown.
13. Conducts OT&E Shakedown data analysis.
14. Provides a deployment recommendation based on OT&E Shakedown results in support of the DRR.
15. Monitors, and optionally participates, in test conduct of Field Shakedown.

4.1.10 NAS System Analysis and Integration Division (ASD-120).

1. Reviews FAA TEMP.
2. Provides the NAS-SS-1000 System Specification requirements for inclusion in the FAA TEMP VRTM, or coordinates requirements for those projects not included in the NAS-SS-1000.
3. Provide inputs to mission needs analysis that serve as the basis for various Key Decision Points.
4. Provide inputs or revised engineering documentation (specifications, Statements of Work, NCPs, TEMPs, etc.) for conformance with system engineering policies, standards, and baseline specifications.

4.1.11 System Engineering Management (ASD-140).

1. Serves as TPRC Secretariat.
2. Formulates revisions to test policy, test standards and definitions for consideration and endorsement by the TPRC.
3. Verifies compliance with FAA Order 1810.4B and standards.
4. Develops and maintains the TPRC Operating Procedures.
5. Provides and maintains implementation traceability for NAS Verification via the VRTM's contained in the NAS-SS-1000 System Specification.
6. Develops VRTM's for new NAS-SS-1000 System Specification projects and NAS IRD's.

4.1.12 Office of Independent Operational Test & Evaluation Oversight (ATQ).

1. Member of TPRC.
2. Provides independent oversight of all ITWS testing efforts.
3. Assesses operational suitability and effectiveness of the ITWS system.
4. Co-approves the TEMP.
5. Reviews and comments on DT&E and OT&E plans, procedures, and reports.
6. Provides operational readiness assessment reports to the FAA Administrator.

4.1.13 Associate Administrator for Contracting and Quality Assurance (ASU).

1. Member of TPRC.

2. Reviews and approves PD’s.
3. Reviews FAA TEMP and contractor's MTP.
4. Reviews DT&E test plans, procedures and reports.
5. Reviews PAT&E test plans, procedures and reports.
6. Verifies completeness of program by reviewing the final OT&E I/O testing, Shakedown and Field Shakedown reports from each site.
7. Provides Associate Program Manager for Quality (APMQ) and Quality Reliability Officer (QRO).

4.1.14 Office of Air Traffic System Management (ATM).

1. Reviews Field Shakedown requirements, plans, procedures, and reports.
2. Determines the operational acceptability of new ATC operational computer programs or systems prior to their delivery for operational testing and use in field facilities.
3. Monitors OT&E Operational testing.
4. Monitors Field Shakedown.
5. Monitors computer program implementation schedules to ensure operational requirements are met.
6. Manages requirements for new airspace management systems.
7. Reviews PD's via ATR.

4.1.15 Air Traffic Rules and Procedures Service (ATP).

1. Reviews Field Shakedown requirements, plans, procedures, and reports.
2. Monitors Field Shakedown.
3. Develops procedures for system implementation.
4. Reviews PD's via ATR.

4.1.16 FAA Contracting Officer.

1. Approves DT&E and PAT&E test plans, procedures, and reports for contractual compliance.
2. Ensures DT&E tests are conducted per contract.

4.1.17 Regional Air Traffic Division.

1. Support PM via ATR in development of test requirements for inclusion in the FAA TEMP.

2. Supports PM in implementation of FAA TEMP at test and operational facilities, as required by ATR.
3. Supports Airway Facilities Division in the development

of Field Shakedown requirements, plans, procedures, and reports, with the inclusion of Regional Air Traffic Division objectives and interests.

4. Provides coordination to Airway Facilities Division for Field Shakedown requirements, plans, procedures, and reports.
5. Participates in the conduct of OT&E Integration and OT&E Operational testing, and OT&E Shakedown, as coordinated with the ATR organization.
6. Supports Field Shakedown that is in satisfaction of Regional Air Traffic Division test requirements or objectives, as coordinated with Airway Facilities Division.
7. Conducts Field Shakedown in coordination with Airway Facilities Division.
8. Monitors Field Shakedown.
9. Reviews PD via ATR.

4.1.18 Air Traffic Facilities.

1. Participates in FAA TEMP activities as required by ATR through Regional Air Traffic Division.
2. Supports development of Field Shakedown requirements, plans, procedures, and reports, in coordination with facility Airway Facilities organizations.
3. Conducts and monitors Field Shakedown and reports results in coordination with facility Airway Facilities organizations and Regional Air Traffic Division.
4. Reviews PD via ATR and Regional Air Traffic Division.

4.1.19 Regional Airway Facilities Division.

1. Supports PM in development of test requirements for inclusion in FAA TEMP.
2. Supports PM in implementation of FAA TEMP at test and operational facilities.
3. Responsible for overall Field Shakedown, in cooperation with Air Traffic Division.
4. Co-approves, jointly with Air Traffic Division, Field Shakedown requirements with the PM.
5. Approves Field Shakedown plans, procedures, and reports.
6. Participates in the conduct of OT&E Integration and OT&E Operational testing, and OT&E Shakedown, as coordinated with AOS.

7. Directs Field Shakedown that is in satisfaction of Airway Facility Division test requirements or objectives, and as coordinated with Air Traffic Division.
8. Conducts Field Shakedown in coordination with Air Traffic Division. AOS-250 have option of participating in test conduct.

4.1.20 Airway Facilities Sectors.

1. Participates in FAA TEMP activities as required by Airway Facilities Division.

2. Develops Field Shakedown requirements, plans, and procedures, in coordination with facility Air Traffic organization.
3. Conducts Field Shakedown, including Joint Acceptance Inspection (JAI), and reports results in coordination with facility Air Traffic organization.

4.1.21 Test Plan Working Group (TPWG).

1. Meet periodically to discuss test related issues concerning the TEMP, DEMVALs, OT&E schedules, and other related issues.
2. Provide input for test requirements and represent respective organizations regarding acceptance of test responsibilities and input for test requirements.

4.1.22 MIT/LL.

1. Provide technical support/meteorological background on algorithms.
2. Support overall test effort on the technical and scientific background of the ITWS.
3. Operate ITWS functional prototypes in support of OT&E Testing at MEM, MCO and DFW.

4.1.23 Communications/Infrastructure (ACT-330).

1. Conduct RMS/MPS interface testing during OT&E Integration.

4.2 INTEGRATED SCHEDULE.

Appendix B contains the ITWS Integrated Test Schedule. The ITWS Test Schedule details the sequential relationship of all T&E

events and milestones relative to the key acquisition events of the program. System development will begin in the 1996 time frame with OT&E beginning in 1999. The schedule will be updated as confirmed dates become available. The ITWS Test Schedule is highly dependent on successful and timely TDWR installation.

Key milestones of the schedule are the Preliminary Design Review (PDR), Critical Design Review (CDR), DT&E, Test Readiness Review (TRR), Contract Acceptance Inspection (CAI), and first Operational Readiness Demonstration (ORD). The PDR is an early opportunity for the FAA to examine the high level design of the contractor developed system. The contractor will present the detailed design to the FAA at the CDR. At this point the program can move into the software development phase. The DT&E phase will present the FAA with a series of opportunities to monitor development. DT&E will commence immediately a successful TRR. The TRR will indicate the preparedness for the FAT, which will transition the system from the factory to an operational site. The system transition of ownership from the contractor to the FAA occurs at CAI. The first ORD is part of Field Shakedown Testing and precedes system commissioning.

4.3 TEST & EVALUATION PERSONNEL AND FUNDING.

The manpower and funding profile estimated to support testing through fiscal year 2001 by test phase is presented in Table 4.3-1. AOS personnel and training is defined in section 5.5.3.3. Funding for the AOS-250 PSF is approximately 500K and should be available in FY-98.

Table 4.3-1 ACT-320 Test & Evaluation Personnel and Funding

ACT-320 T&E SUPPORT								
FY	96	97	98	99	2000	2001	M/Y	TOTAL
Testing Phase	M/Y	M/Y	M/Y	M/Y	M/Y	M/Y	TOTAL	$/Test Phase
Demonstration (96)	0.50	0.00	0.00	0.00	0.00	0.00	0.50	$62,500
DT&E (96-99)	2.00	2.50	3.00	2.00	0.00	0.00	9.50	$1,187,500
OT&E (96-01)	2.00	2.50	3.50	3.50	2.00	2.00	15.50	$1,937,500
PAT&E (99-01)	0.00	0.00	0.00	0.50	2.00	1.00	3.50	$437,500
P3I (97-01)	0.00	0.00	0.00	1.00	2.00	2.00	5.00	$625,000
Total M/Y	4.50	5.00	6.50	7.00	6.00	5.00	34.00	$4,250,000
Ttl Prgm $/FY (*125K/MY)	$562,500	$625,000	$812,500	$875,000	$750,000	$625,000	$4,250,000	
PAT&E/P3I	0.00	0.00	0.00	1.50	4.00	3.00	8.50	$1,062,500

4.4 TEST PLANS.

Table 4.4-1 lists the Development Phase test documents, expected completion dates, and responsible organizations.

Table 4.4-1 Development Phase Test Plans

Development Phase Test Plans		
Document Title	Expected Completion Date	Responsible Organization
FAA TEMP	Apr-95	ACT-320
Human Factors Plan	Mar-95	ACT-320
FAA OT&E Operational and Integration Test Plan	Feb-98	ACT-320
OT&E Shakedown Test Plan	Feb-98	AOS-250
Contractor's Master Test Plan (CMTP)	TBD	Development Contractor
Software Test Plan	TBD	Development Contractor
DT&E FAT Plan	TBD	Development Contractor
DT&E SAT Plan (includes Delta DT&E Test requirements)	TBD	Development Contractor
PAT&E FAT Plan	TBD	Development Contractor
PAT&E SAT Plan	TBD	Development Contractor

4.4.1 Government Test Plans.

A set of test plans will be developed by the organizations responsible for each T&E phase identified within this TEMP. Test plans define the range of tests to be performed, input data, initialization requirements, expected output, qualitative methods and criteria for evaluating test results.

4.4.1.1 FAA TEMP.

The FAA TEMP is written by the government and is in accordance with FAA-STD-024b. The document details the overall test

philosophy throughout the DT&E, OT&E and PAT&E test phases.

4.4.1.2 Human Factors Plan.

The Human Factors plan is prepared by the government and outlines the proposed approach and methodology to be utilized to address human engineering issues throughout the acquisition cycle. This plan will drive all test and evaluation efforts regarding operator performance and display issues.

4.4.1.3 FAA OT&E Operational and Integration Test Plan.

This plan is prepared by the government and is used to ensure that the NAS requirements are thoroughly tested. It will also test the system to verify that interfaces between existing NAS systems are not degraded due to the introduction of the new system.

4.4.1.4 OT&E Shakedown Test Plan.

The OT&E Shakedown Test Plan defines the OT&E testing within the operational environment. This testing will also verify the readiness of personnel and procedures with respect to the system.

4.4.2 Contractor Test Plans.

The contractor will develop a series of test plans to successfully test the system through the DT&E and PAT&E test phases.

4.4.2.1 Contractor Master Test Plan (CMTP).

The CMTP defines the overall test philosophy of the contractor and summarizes tests required to be conducted by the contractor in the DT&E and PAT&E test phases. It details the methods for implementing and controlling the various testing programs.

4.4.2.2 Software Test Plan (STP).

The STP defines the scope of testing to be conducted at the software development level. It will provide plans for unit tests, computer software components and computer software configuration items. The testing will validate the major ITWS system components of communications, processing and control. Additionally, this plan will define software test cases and post-conduct analysis to determine the effectiveness of the GFE (meteorological algorithms).

4.4.2.3 DT&E Factory Acceptance Test (FAT) Plan.

The DT&E FAT Plan is prepared by the contractor and details the pre-delivery system testing to be conducted by the contractor within the their facility. This testing will be conducted on the first article systems. This plan contains the criteria for pass/fail of specification requirements.

4.4.2.4 DT&E SAT Plan.

The DT&E SAT Plan is prepared by the contractor and will identify the testing to be conducted at the first article site location. This plan will include the Delta DT&E test requirements which will incorporate tests that were unable to be accomplished at the contractors facility.

4.4.2.5 Production Acceptance Test & Evaluation (PAT&E) FAT Plan.

The PAT&E FAT Plan is prepared by the contractor and details the test methodology on each production unit to be conducted at the contractor's facility. This will ensure that the production units meet the same requirements of the first article systems previous test phases.

4.4.2.6 PAT&E SAT Plan.

The PAT&E SAT Plan is prepared by the contractor and describes the testing for each production unit to be conducted at the system delivery sites. This will ensure that the production units meet the same requirements as those sent to the first operational sites.

4.5 TEST PROGRAM RESOURCES.

This section identifies resources required to support the ITWS test program.

4.5.1 Manpower and Training.

The ITWS test team includes AT, AF, AND-460, ACT-320, ACT-330, AOS-250 and support contractor personnel. The personnel shall receive training in the areas of multi-tasking operating systems, communication protocols and networks, and ITWS specific operations as applicable. Training will also include software, hardware, system operator, configuration management and test tool training. Training for the test team will be completed

prior to the commencement of OT&E.

Additionally, on the job training for the OT&E test team will be acquired through discussions with the ITWS contractor throughout the development and DT&E process, reading and studying various system information contained in manuals and other system documentation. Experience will also be gained through hands-on system operation during pre-OT&E activities. The regional support personnel manpower requirements are outlined in Table 4.5.1-1.

Regional Airway Facilities Division Personnel Resources To Support ITWS Test Planning								
Quantity	Regional AF	Support Hours by Fiscal Year						
		1996	1997	1998	1999	2000	2001	Tot Hrs.
TBD	New England	40	80	120	160	100	100	600
TBD	Eastern	40	80	120	160	100	100	600
TBD	Southern	40	80	120	160	100	100	600
TBD	Southwest	40	80	120	160	100	100	600
TBD	Central	40	80	120	160	100	100	600
TBD	Great Lakes	40	80	120	160	100	100	600
TBD	NW Mountain	40	80	120	160	100	100	600
Total Hours:		280	560	840	1120	700	700	4200

Table 4.5.1-1

4.5.2 Test Articles.

The first delivery test articles will consist of four complete IOC ITWS system suites. The first site will be the FAA Technical Center in Atlantic City, NJ. The second and third sites will be located at the simple and complex sites which are presently TBD. The fourth unit will be delivered to the PSF in Oklahoma City, OK.

4.5.3 Test Sites.

Testing will be conducted at the first three facilities listed in section 4.5.2.

4.5.4 Test Support Equipment.

The following is a list of anticipated test equipment required for the ITWS test program. Table 4.5.4-1 lists the anticipated funding to support system communications during the test phases. Additional test equipment may be required as the T&E program progresses.

- A contractor-developed test tool will be required to play back weather data recorded from ITWS input sensors. This tool will be a development contractor deliverable and will be used at the FAA Technical Center to develop and execute weather scenarios that test the ITWS interfaces and system performance.

- Protocol analyzers will be used throughout the ITWS testing cycle for validation, interpretation and trouble-shooting of the system's communications.

- MIT/LL algorithm development facilities will be enhanced to assist in offline Data Reduction and Analysis (DR&A) of recorded sensor data sets.

- A test suite at the FAA Technical Center will be required to support meteorological data analysis of the ITWS products and to display raw input data and intermediate products for comparison to ITWS products. The test suite will consist of several workstations displaying raw sensor input and intermediate products. Application software to support the test suite will be provided by MIT/LL.

- Communication lines and modems to support integration testing at the Technical Center. Seven dedicated communication lines and modems are anticipated for the interface testing. The lines will require a minimum of a 9600 KBPs and T-1 rates.

- AOS support equipment will be provided when available.

MATERIAL RESOURCES DESCRIPTION								
FY	96	97	98	99	2000	2001	2002	TOTAL
Line Item	$K	$K	$K	$K	$K	$K	$K	$K
Interface Comm Lines (FAATC)	$0	$0	$5	$25	$10	$5	$5	$50
Comm Lines for DR&A	$0	$5	$5	$10	$5	$5	$5	$35
Modems	$0	$2	$5	$5	$0	$0	$0	$12
ACT Total Material Funding	$0	$7	$15	$40	$15	$10	$10	$97

Table 4.5.4-1 Material Resource Funding

4.6 TEST CONFIGURATION MANAGEMENT.

The contractor will follow configuration management guidelines in accordance with the FAA-STD-021, FAA-STD-026, FAA Order 1800.8F, and DOD-STD-2167A for software development. The configuration management program will establish a Software Configuration Control Board (SCCB). The SCCB establishes a baseline for software requirements, software design and developed software. Any changes to the baselined requirements or design are submitted to the SCCB for approval. Requirement and design changes are submitted via an Engineering Change Proposal (ECP).

The configuration management program will consist of FCA and PCA. Configuration audits will be conducted by the Program Office or designated representatives.

The FCA is a formal examination of functional characteristic test data for a configuration item, prior to acceptance, to validate that the item has achieved the performance and functional characteristics specified in its functional or allocated configuration identification. The PCA is a formal examination of the "as-built" configuration of a unit to verify that it conforms to its technical design in order to establish the configuration item's initial product configuration identification.

During testing, the test team will be responsible for documenting the configuration during each phase of testing. Test procedures and data sheets will be used to document any configuration changes. Test data will be analyzed in accordance with any configuration changes.

4.7 TEST PLANNING WORK GROUP.

The TPWG consists of representatives from ACT-320, ASD-140, ATQ-3, ATR-330, ASD-120, AOS-250, and AND-460. The TPWG meets periodically to discuss test related issues including TEMP development, DEMVALs, OT&E schedules, etc. MIT/LL is a current member and may be included in the future, as will the development contractor. The organizational representatives will provide input for test requirements and represent their respective organizations regarding acceptance of test responsibilities.

4.8 METEOROLOGICAL EVALUATION PANEL.

A panel of independent experts will perform an assessment of ITWS product performance. This science panel will evaluate any changes to the algorithms that have occurred since the panel last met. The panel will be ongoing and will provide input to test personnel and assist in resolving OT&E issues.

5.0 T&E PROGRAM DESCRIPTION.

5.1 COMPLETED DT&E/PAT&E.

There has been no DT&E/PAT&E performed on the ITWS. The DT&E test phase will begin at completion of the TRR.

5.2 COMPLETED OT&E.

An informal DEMVAL was conducted at Orlando and Dallas in 1993. This DEMVAL was an initial verification of the ITWS' capability to meet Air Traffic weather requirements and produce scientifically valid products. An independent science panel was convened in 1993 to review the science of the ITWS algorithms. Based on the results of the 1993 DEMVAL and Science Panel findings, the program office decided to proceed with a formal DEMVAL in 1994. The Demonstration Phase OT&E (DEMVAL) was conducted at Orlando and Memphis during the Summer of 1994. The test reports are listed below.

ACW-200 Report ITWS Operational Test and Evaluation (OT&E) Demonstration/Validation at Orlando, FL and Dallas Fort-Worth, TX (May-September 1993), DOT/FAA/CT-TN95/1.

ACW-200 Report ITWS Demonstration/Validation Phase OT&E Final Report, (Draft), February 1995.

The following are the ITWS COIs and status from the 1994 DEMVAL. The letters following the COI indicates the corresponding COIs listed in section 3.5 of this document:

1. Are the ITWS products useful during operationally significant weather in terms of their availability, timeliness, and suitability for air traffic use? Are detections and false alarm rates acceptable to users? (g,h)

Status: Partially resolved; further product suitability, detection and false alarm evaluations required.

2. Are the ITWS products displayed with out the need for further meteorological interpretation? Is the displayed information understandable? (e,j)

Status: Resolved

3. Does the ITWS reduce (perceived) controller workload during adverse weather conditions in the terminal area? (k)

Status: Resolved

4. Do ITWS products enhance the effectiveness of traffic planning/management during adverse weather conditions in the terminal area? Are terminal airspace and runways planned for and used more effectively? (i)

Status: Resolved

5. Does the unavailability of interfacing systems/sensors adversely affect ITWS operations? (a,b,f)

Status: Partially Resolved; The unavailability of certain input sensors (e.g., TDWR, LLWAS) during the DEMVAL did not preclude the ITWS from producing useful products to air traffic personnel. The system reaction to sensor loss and subsequent reacquisition of sensor input will be evaluated during OT&E along with the user response to sensor loss.

5.3 DEMONSTRATION TEST & EVALUATION (DT&E) TESTING.

5.3.1 DT&E Program Description.

DT&E is conducted to assist in the engineering and development process by determining the degree to which functional engineering specifications are addressed. DT&E includes test and evaluation of subsystem hardware and software on full-scale engineering models.

DT&E will be conducted in accordance with FAA-STD-1810.4B and the FAA approved Contractor Master Test Plan (CMTP). ACT-320 will be responsible for monitoring all aspects of the ITWS DT&E testing cycle. A design qualification test (DQT) will be conducted and witnessed by the QRO or APMT to determine whether the product can successfully achieve all specified physical, functional and performance requirements.

Acceptance tests and procedures that will be conducted on production models will also be demonstrated. DT&E will verify that the Specification requirements of FAA-E-XXXX are met and that the developed interfaces are correctly implemented according to applicable IRDs. Operational elements of the DT&E phase are depicted in Figure 5.3-1.

Figure 5.3-1 (DT&E)

5.3.2 DT&E Factory Acceptance Testing (FAT).

As part of the DT&E effort, the contractor will plan and conduct a DT&E FAT of the ITWS, which will be formally witnessed by the FAA. The DT&E FAT will verify the capability of ITWS to meet all functional, interface, and performance requirements of FAA-E-XXXX. DT&E FAT is conducted at the contractor's facility and will be conducted by the contractor using FAA approved, contractor test plans and procedures. The contractor is responsible for the timely and satisfactory completion of testing in accordance with the ITWS schedule.

5.3.3 DT&E Site Acceptance Testing (SAT).

DT&E SAT is performed by the system developer on the systems delivered to each of the test sites before acceptance of the subsystem by the FAA Contract Acceptance Inspection (CAI). The purpose of this testing is to ensure that the systems are properly installed, ready for operation, and include all necessary equipment. This testing is monitored by government personnel.

The contractor will conduct testing of the ITWS at each operational facility before acceptance of the subsystem by the FAA Contract Acceptance Inspection (CAI). SAT procedures will also be validated during DT&E.

As part of DT&E SAT, Delta DT&E will be conducted by the contractor at the FAA Technical Center. This will test the interfaces which were not available at the contractor's facility and exist within the FAA Technical Center.

5.3.4 Development Contractor Test Documentation.

The development contractor will prepare a CMTP in accordance with the Data Item Description (DID) and Contract Data Requirements List (CDRL) specified in the SOW. This CMTP provides information that pertains strictly to DT&E, PAT&E, FAT and SAT testing. This document will show traceability to the ITWS specification and VRTM. Additionally, the contractor will develop and have FAA approval of FAT/SAT plans for the first article delivery. These plans/procedures will have pass/fail criteria for each of the requirements tested.

The CMTP will be developed from the DT&E and PAT&E test requirements stated in the Quality Assurance section of the FAA-E-XXXX and the SOW. The CMTP will be updated as required throughout the contract to reflect any ECPs and/or contract modifications that alter the testing program. DT&E test plans

will be prepared in accordance with the DIDs and CDRLs specified in the SOW.

5.3.5 Government Responsibilities.

The government will prepare the ITWS Specification (FAA-E-XXXX), SOW and TEMP documents. The TEMP will contain the VRTM and the VRTM will contain the ITWS requirements specified in NAS-SS-1000 Volumes I-V.

Presently, the ITWS specification is not baselined. When baselined the VRTM will be updated to map the specification requirements to the NAS requirements. The revised VRTM will be submitted for TPRC approval.

This VRTM will be used to ensure that the prime contractor tests the same set of requirements upon which the system was designed. The government will identify CPPs, COIs and Exit Criteria (see section 3.4.1, 3.5 and 3.4.2, respectively) that will be used to transition the ITWS from DT&E to OT&E and OT&E to KDP-4. OCD will not be performed on the ITWS.

5.4 PRODUCTION ACCEPTANCE TEST & EVALUATION TESTING (PAT&E).

The contractor will conduct PAT&E on each production unit to verify that the product conforms with all provisions of the contract and meets the stated requirements. The tests shall be conducted in accordance with the FAA approved PAT&E test plans and procedures. The Technical On-site Representative will also be involved with this test phase to assist in maintaining the facility data reference file and to insure user readiness for system sell off. Operational elements of the PAT&E phase are depicted in Figure 5.4-1.

5.4.1 PAT&E Factory Acceptance Testing (PAT&E FAT).

During PAT&E, FAT is conducted by the contractor at their factory for each delivered item to verify that it conforms to applicable specifications and requirements. A limited subset of DT&E FAT requirements will be performed on each PAT&E article. Successful completion of PAT&E FAT represents a partial FAA acceptance of the production article.

5.4.2 PAT&E Site Acceptance Testing (PAT&E SAT).

SAT testing is conducted to verify the effective installation of the ITWS into each facility and to verify the suitability of the system for field shakedown testing and AT operations.

Figure 5.4-1 (PAT&E)

5.5 OT&E TESTING.

OT&E integration and operational testing will be conducted concurrently. Where possible, Shakedown testing will be conducted with OT&E Integration and Operational Testing.

The OT&E integration test environment will include the FAA Technical Center for initial interface integration testing, followed by testing in air traffic operational environments. ACT-320 will develop the OT&E Test Plans and Procedures in accordance with FAA Order 1810.4B and FAA-STD-024b. These Plans and Procedures will present each requirement with pass/fail criteria.

AT and AF personnel will be actively involved in the hands-on evaluation of the ITWS equipment. The OT&E will be conducted primarily in an operational environment to evaluate the effectiveness and suitability of the ITWS into the NAS.

The planned approach for resolution of COIs during OT&E is presented in section 3.5. Test limitations that may impact the resolution of the COIs and impede the ITWS OT&E testing are ITWS dependencies on other systems for input data and the absence of hazardous weather phenomena. The CPPs found in section 3.4.1 will be tested in accordance with the VRTM found in Section 7 of this document.

The OT&E testing will be performed in the following three phases:

Phase 1: Interface/Integration Facility; (FAA Technical Center, Atlantic City, NJ);

Phase 2: Operational Site; simple site (TBD);

Phase 3: Operational Site; complex site (TBD).

This phased approach ensures a structured methodology for examining and resolving COIs and OT&E requirements. Additionally, it provides a framework that requires verification of the system has met the exit criteria and can proceed into the next phase. Operational elements of OT&E are depicted in Figure 5.5-1.

Figure 5.5-1 (OT&E Elements)

5.5.1 OT&E Integration Testing.

OT&E Integration consists of testing the NAS system end-to-end performance. The ITWS VRTM lists the requirements from the NAS-SS-1000 Volumes I-V, that will be tested throughout the test phases.

5.5.1.1 OT&E Integration Test Program.

This testing will ensure the successful integration of NAS systems, subsystems, and end-to-end performance requirements. The subsystems will be tested in a NAS system equivalent environment. The ultimate goal of integration testing is to ensure that the new system's end-to-end performance does not adversely impact operational NAS systems or subsystems and that system performance achieves the goals.

The OT&E integration testing will verify the communication layers in accordance with the appropriate ISO standard for each of the ITWS interfaces. Additionally, this methodology will confirm that each of these interfaces are in conformance with the applicable IRDs and ICDs before the testing of the applications software begin.

ACT-320 will provide the methodology for testing the ADAS, LLWAS, TDWR, NEXRAD and other ITWS interfaces. This will be completed either through actual connection or simulation. After individual interface testing has been completed, testing with multiple interfaces will be conducted.

5.5.1.1.1 Phase 1 - OT&E Integration Testing.

The purpose of the interface/integration facility testing is to mitigate interface problems before they are encountered in an operational environment. This testing will utilize the interfaces available within the FAA Technical Center. Limited operational testing will also be conducted at this facility by using real-time data acquired from operational sensors located at the Atlantic City International (ACY) and Philadelphia International (PHL) airport facilities. The impact of sensor input loss to the ITWS and to ATC personnel will be initially assessed. RMS integration testing will also be addressed during this phase. Refer to the interface/integration facility configuration diagram, Figure 5.5.1.1.1-1.

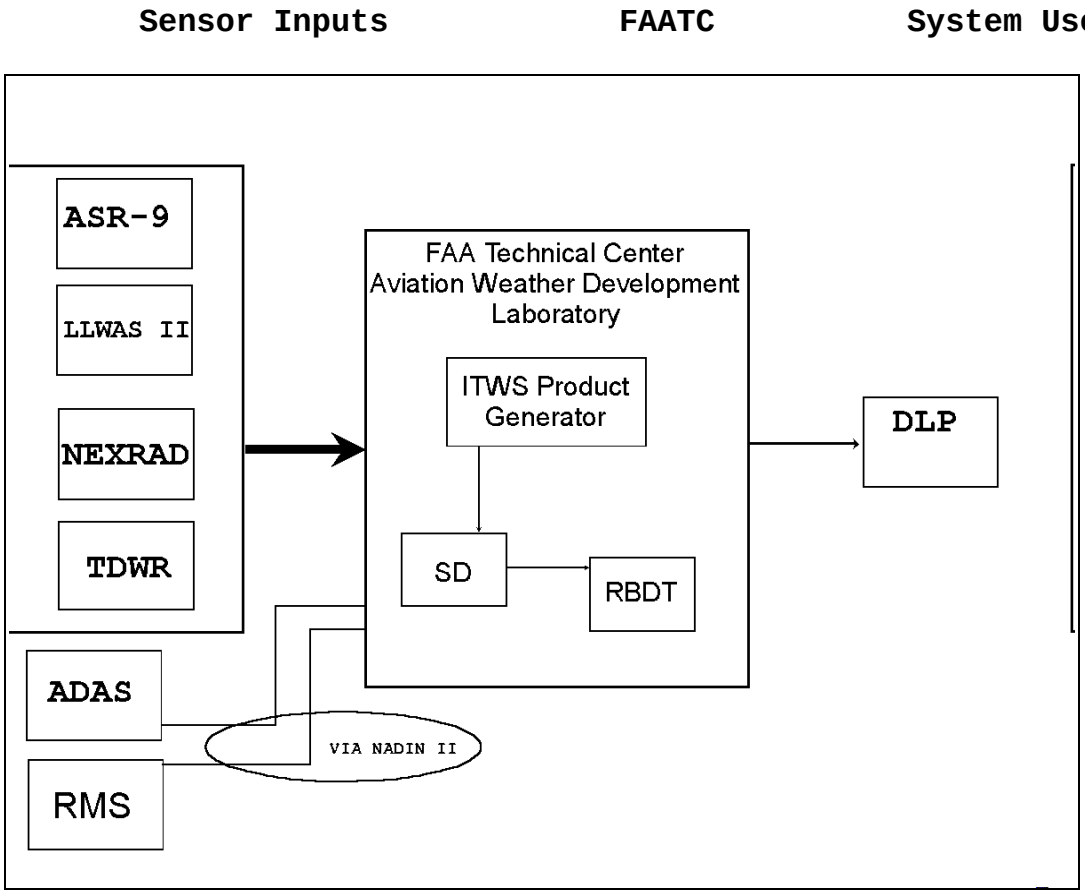

Figure 5.5.1.1.1-1

5.5.1.1.2 Phase 2 - OT&E Integration Testing.

The OT&E Integration testing will be conducted in an air traffic operational facility. Simple site testing, currently TBD, will assess interface functionality within an air traffic environment. This will verify the ITWS capability of interfacing with all designed system inputs. This configuration will include a single input from each of the ITWS interfaces. Refer to the simple site configuration diagram example in Figure 5.5.1.1.2-1. OT&E operational testing will also be conducted at this facility.

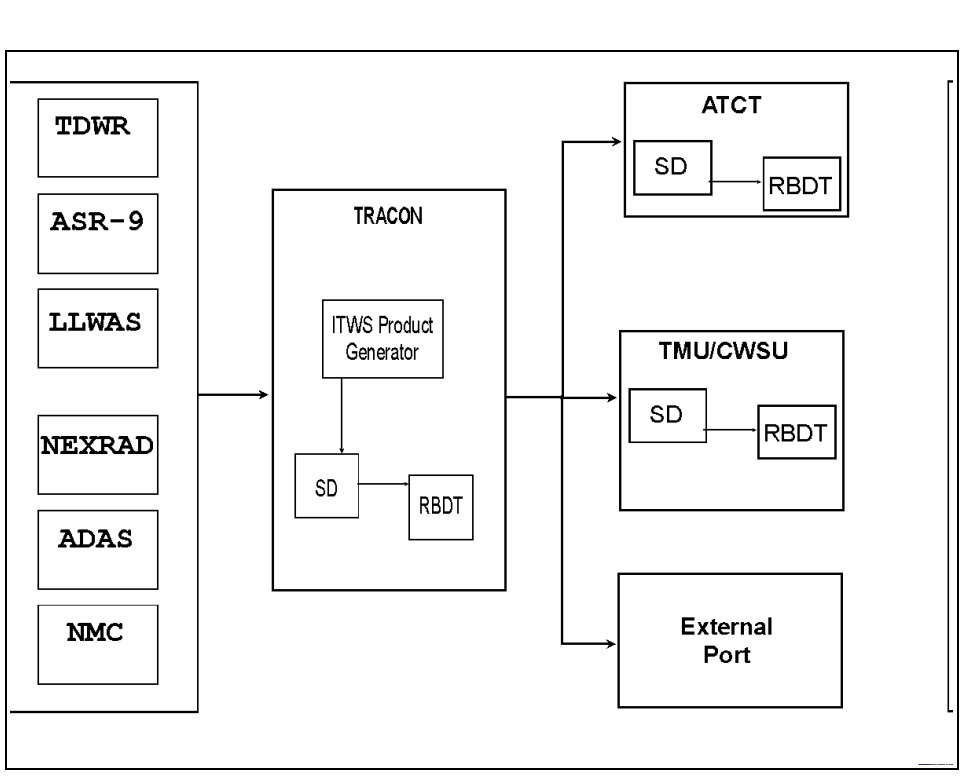

Figure 5.5.1.1.2-1

5.5.1.1.3 Phase 3 - OT&E Integration Testing.

The complex site, currently TBD, will be conducted in an air traffic operational facility. It is analogous to the simple site testing with the exception that the complex site will ingest inputs from multiple radars and airports. Refer to the complex configuration diagram example in Figure 5.5.1.1.3-1. OT&E operational testing will also be conducted at this facility.

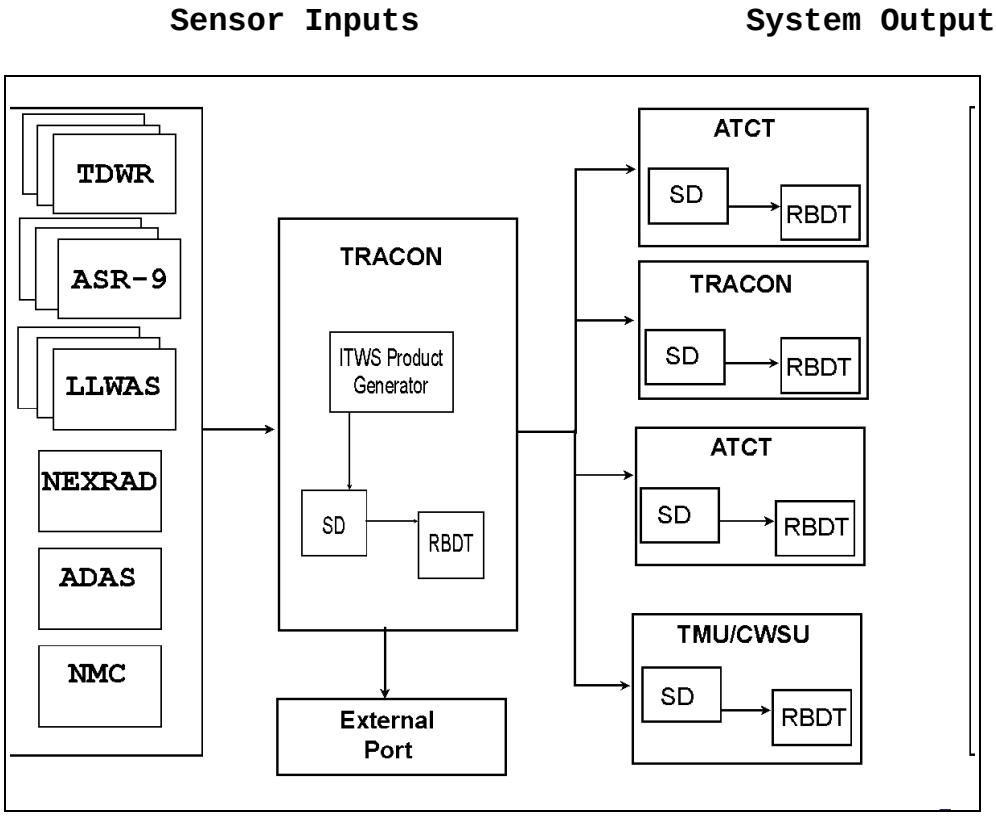

Figure 5.5.1.1.3-1

5.5.1.2 Schedule.

Refer to the Integrated Schedule in Appendix B.

5.5.1.3 Key Sites: Anticipated OT&E integration test sites.

1. FAA Technical Center, Atlantic City, NJ;
2. simple site, TBD;
3. complex site, TBD.

5.5.1.4 Training.

AT and AF personnel participating in DT&E/OT&E will require training on the ITWS prior to utilizing the products and participating in evaluations. Training will be developed by the contractor in accordance with the terms of the SOW. The AT personnel will also require training on the ITWS in preparation for the 1995 and 1996 testing. Additional training requirements are defined in section 4.5.1 of this document.

5.5.1.5 Personnel.

The following personnel will be required to prepare for and conduct testing:

1. ACT-320 will provide test engineers, meteorologists support and Human Factor personnel to develop plans, procedures and reports, and conduct testing. Personnel requirements and estimated costs are presented in paragraph 4.3. Additionally, ACT-320 will require planning support to assist the Program Office in maintaining a workable schedule and will track action items and record proceedings of the Test Schedule Status Reviews (TSSR).

2. ACT-330 will provide test engineers to draft plans, procedures, conduct testing and draft reports. Budgeting, staffing and training test personnel will be the responsibility of ACT-330.

3. AOS-250 personnel requirements are defined in section 5.5.3.3.

4. AT personnel will provide trained operators to participate in the operational test environment to evaluate the effectiveness and suitability of the ITWS.

5. AF regional technicians will be required for system and maintenance support. A Memorandum of Agreement (MOA) will be prepared and coordinated.

6. Prime contractor support for OT&E is defined within the SOW and will occur prior to software development completion.

5.5.2 OT&E Operational Testing.

The following sections describe the OT&E Operational Test Program that will verify the operational effectiveness and suitability of ITWS to fulfill its NAS mission from both an AT and AF perspective.

Key sites, training and personnel are similar to those described in the DT&E activities described in section 5.5.1.

Operational elements of OT&E are depicted in Figure 5.5-1. Each of the elements comprising the OT&E integration testing is defined in subsections a - j.

a. Reliability.

The reliability program will be in accordance with MIL-STD-785 and will ensure that the reliability requirements from the FAA-E-XXXX and SOW are satisfied. Reliability shall demonstrated during OT&E integration. ACT-320 will verify that the ITWS meets all reliability requirements.

b. Availability.

The ITWS will be tested to verify that the system meets the availability requirements from the FAA-E-XXXX and SOW. The availability of the system interfaces will also be examined to determine the availability of the sensor inputs. This will indicate availability of each ITWS product.

c. Degraded Operations.

Degraded operations will be addressed by removing various sensor inputs to the ITWS to assess the resulting operational impact. This will examine the systems ability to function under abnormal operational conditions.

d. Stress and NAS Loading.

The ITWS system will be tested beyond VRTM capacity requirements to verify that system performance does not become degraded. Additionally, this will verify that under this condition, the system will not require further operator assistance to maintain the system in an operational state.

e. Human Factors.

Human Factors will assess end users performance in conducting tasks and human engineering issues associated with the system. Additionally, user workload will be evaluated to for effects on efficiency, productivity and safety.

f. Safety.

The ITWS safety program will be in accordance with MIL-STD-882C and the ITWS SOW.

g. Maintainability.

The maintainability program will be in accordance with MIL-STD-470 and will ensure that the requirements presented in FAA-E-XXXX and the SOW are satisfied. These requirements include the ability of the maintenance personnel to diagnose system faults and perform checkout procedures in accordance with the ITWS maintenance documentation.

h. Site-Adaptation Data.

OT&E will verify the system with a variety of site adaptation parameters. System performance should not be impacted by the altering of system parameters.

i. Security.

The ITWS system will comply with the security requirements indicated within the FAA-E-XXXX and SOW.

j. Transition Switchover.

The ITWS will be evaluated to determine the ability of removing the system without degradation to the NAS environment. This will measured in terms of maintenance of communications and data availability.

5.5.2.1 Operational Test Site Locations.

ITWS OT&E test sites were selected in different regions of the United States to offer a range of weather phenomena. This will ensure that the ITWS is evaluated in various weather data processing capacities. Additionally, the sites selected consist of both simple and multiple sensor configurations. These configurations are delineated by area of coverage for a single or multiple airports. The simple site configuration will provide single radar sensor inputs while a complex site configuration will have multiple radar inputs. Refer to section 5.5.1.1 for site configurations.

5.5.2.2 OT&E Operational Risks That May Adversely Impact Test Completion.

1. The ITWS capabilities need to be tested with controlled input data in order to vary the loading conditions and minimize testing time. It is planned to have this data provided to ITWS via a test tool. This test tool will utilize weather data recorded from around the country over a prolonged period of time. Even with convective weather conditions, this weather data may be insufficient to provide the input data intensity required to test the ITWS past its critical performance thresholds.

2. Although the schedule allows time to collect weather data, due to the inability to control weather phenomena, sufficient data may not be collected within the time allotted. Therefore, testing delays may be incurred.

3. Delays in the TDWR installation schedule may adversely impact the ITWS OT&E schedule.

5.5.2.3 Schedule.

See integrated schedule in Appendix B.

5.5.3 OT&E Shakedown.

OT&E Shakedown Testing will determine the overall readiness of the ITWS through the exercising of the system in an operational environment to support determination that the system is ready for full operation as part of the National Airspace System (NAS). This will include testing to confirm that

when the ITWS is operated and maintained by operational personnel in an operational environment, all requirements are met (see Figure 5.5-1.). Shakedown testing will verify the effectiveness, suitability, maintainability, supportability, and integration requirements of the system.

Effectiveness will assess the system's ability to provide reliable service for consistent product delivery under multiple operational conditions. Suitability will asses the system products and user/system transactions. Maintainability will assess the ease of maintaining the system throughout the operational/non-operational states and to assess the system capabilities of displaying system statuses to the operator. Supportability will ensure that the system's hardware and software is capable of being maintained with the given documentation and training.

System integration testing will assess the ITWS operation and determine any negative impact on the existing air traffic control. Testing will include an assessment of the external inputs to the ITWS which include the systems as shown in Figure 3.2.1-1.

5.5.3.1 OT&E Shakedown Organizations.

Shakedown testing will be conducted by AOS-250 at an operational site. The actual performance of the shakedown tests will be by AT personnel and regional maintenance technicians who will use the services provided by the ITWS and who will have the maintenance responsibility for the selected test sites.

5.5.3.2 OT&E Shakedown Preparation.

AOS-250 will develop the OT&E Shakedown Test Plan and Procedures in accordance with FAA Order 1810.4B and FAA-STD-024B.

5.5.3.3 OT&E Shakedown Personnel and Training.

The following personnel will be required to prepare for and conduct OT&E Shakedown testing.

a. AOS-250 hardware and software engineers will develop the ITWS Shakedown Test Plan and Procedures, prepare

reports, and conduct testing.

b. Regional technicians will be required for system and maintenance support of the system. The AOS-250 shakedown test director will coordinate this effort with the region.

c. AOS-250 meteorologists will provide analysis of the meteorological performance of the ITWS algorithms.

5.5.3.4 Training.

AT personnel participating in shakedown testing will require training on the ITWS prior to utilizing the products and participating in evaluations. Regional maintenance technicians as well as AOS-250 engineers participating in shakedown testing will require system maintenance training on the ITWS prior to system delivery and shakedown testing. Both areas of training will be developed by the contractor in accordance with the ITWS SOW.

5.5.3.5 OT&E Shakedown Test Implementation.

Shakedown testing will be conducted in two phases:

Phase 1: Simple Operational Site

Phase 2: Complex Operational Site

The simple site configuration will provide single radar sensor inputs (see Figure 5.5.1.1.2-1) while a complex site configuration will have multiple radar inputs (see Figure 5.5.1.1.3-1).

Shakedown testing at the simple site configuration will include all elements of validation and verification as shown in Figure 5.5-1. Shakedown testing at the complex site configuration will be centered around validating and verifying system integration of the multiple radar inputs.

Delays in the TDWR and NEXRAD installation schedules may adversely impact the ITWS Shakedown Test schedule.

6.0 ACRONYMS AND GLOSSARY.

ACF	Area Control Facility
ADAS	ASOS/AWOS Data Acquisition System
ADCCP	Advanced Data Communication Control Procedures
AF	Airway Facilities
AGL	Above Ground Level
AIV	Aviation Impact Variable
ALDARS	Automated Lightning Detection and Reporting System
AP	Anomalous Propagation
APME	Associate Program Manager for Engineering
APMQ	Associate Program Manager for Quality
APMT	Associate Program Manager for Test
ASOS	Automated Surface Observing System
ASR	Airport Surveillance Radar
ATC	Air Traffic Control
ATIS	Automated Terminal Information System
ATR	Air Traffic Plans & Requirements Service
AWOS	Automated Weather Observing System
AWP	Aviation Weather Products
CAB	Configuration Control Board
CAI	Contract Acceptance Inspection
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CMTP	Contractor's Master Test Plan
CPP	Critical Performance Parameters
COI	Critical Operational Issues
COTS	Commercial-Off-The-Shelf
DCE	Data Communications Equipment
DEMVAL	Demonstration/Validation
DFW	Dallas-Fort Worth International Airport
DID	Data Item Description
DLP	Data Link Processor
DQT	Design Qualification Test
DRR	Deployment Readiness Review
DTE	Data Terminating Equipment

DT&E Development Test and Evaluation
EXCOM Executive Committee
FAA Federal Aviation Administration
FAATC Federal Aviation Administration Technical Center
FAATG Federal Aviation Administration Telecommunications Gateway
FAT Factory Acceptance Testing
FCA Functional Configuration Audit
FSD Full Scale Development
GFE Government Furnished Equipment
GFI Government Furnished Information
IC&A Initial Checkout and Acceptance
ICD Interface Control Documents
ICDDT Interface Control Document Database Development Tool
IMCS Interim Monitor Control Software
IOC Initial Operational Capability
IOT&E Independent Operational Testing and Evaluation
IRD Interface Requirement Documents
ISO International Standards Organization
IPT Integrated Product Team
ITWS Integrated Terminal Weather System
KDP Key Decision Point
LLWAS Low Level Wind Shear Alert System
MCF Metroplex Control Facility
MCO Orlando International Airport
MDCRS Meteorological Data Collection and Reporting System
MEM Memphis International Airport
MIT/LL Massachusetts Institute of Technology Lincoln Laboratory
MAOPR Minimum Acceptable Operational Requirements
MNS Mission Need Statement
MOA Memorandum of Agreement
MPS Maintenance Processor Subsystem
MTBF Mean Time Between Failure
NAS National Airspace System
NCP NAS Change Proposal
NEXRAD Next Generation Weather Radar
NWS National Weather Service

NWSTG	National Weather Service Telecommunications Gateway
OCD	Operational Capability Demonstration
ORD	Operational Requirements Document
ORD	Operational Readiness Demonstration
OSI	Open System Interconnection
OT&E	Operational Test and Evaluation
PAT&E	Production Acceptance Test and Evaluation
PCA	Physical Configuration Audit
PD	Program Directive
PDR	Preliminary Design Review
PM	Program Manager
PIP	Program Implementation Plan
PSF	Program Support Facility
PSN	Packet Switching Network
PUP	Principle User Processor
QRO	Quality Reliability Officer
RBDT	Ribbon Display Terminal
RPG	Radar Product Generator
RMMS	Remote Maintenance Monitoring System
RMS	Remote Monitoring Subsystem
SAT	Site Acceptance Testing
SAV	State of Atmosphere Variable
SD	Situation Display
SOW	Statement of Work
STD	Standard
STP	Software Test Plan
T&E	Test and Evaluation
TBD	To Be Determined
TCCC	Tower Control Computer Complex
TDWR	Terminal Doppler Weather Radar
TEMP	Test and Evaluation Master Plan
TPRC	Test Policy Review Committee
TPWG	Test Planning Work Group
TRACON	Terminal Radar Approach Control facility
TRR	Test Readiness Review
TSSR	Test Schedule Status Reviews
VRTM	Verification Requirements Traceability Matrix
WMO	World Meteorological Organization

7.0 VERIFICATION REQUIREMENTS TRACEABILITY MATRIX.

Due to changing ITWS requirements and interface designs, the VRTM is being updated. The VRTM template in Appendix A denotes the format in which the requirements will be presented.

Presently, the ITWS specification is not baselined. When baselined the VRTM will be updated to map the specification requirements to the NAS requirements. The revised VRTM will be submitted for TPRC approval.

8.0 INDEPENDENT OPERATIONAL TEST AND EVALUATION OVERSIGHT.

TBD

APPENDIX A - VRTM

Refer to section 7.

APPENDIX B - SCHEDULE